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THE APPLICATION OF FOOD ACCEPTANCE METHODS  
AND RESULTS TO MILITARY FEEDING PROBLEMS

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Before proceeding to the major purpose of this talk, which is a presentation and analysis of food acceptance problems and results from the practical viewpoint of the military, I should like to express a thought that you may find particularly interesting - and pertinent - on this occasion. It is one of those "we point with pride" ideas. What other nation, in a world filled with privation and threats of famine, could possibly devote as much time, energy, and brain power as we are doing to the study of what foods people like and how well they like them. For so many countries, the food need but have the property of edibility; then the amount of food available, becomes the predominant interest. This contrast I see as another example of the vital strength of our nation, arising from its productive might, its great agricultural and industrial capacity. Food is made available in great quantity and variety, which permits us to operate at a definitely higher level. It is in trying to make the best use of these opportunities that we meet the group of problems that make up the field of food acceptance.

Now, so that many of you will not begin to worry that the Army is changing too radically since you knew it, I hasten to give you assurance that concern with how good or bad food tastes and how readily the soldier eats it is not maintained in order to pamper the American service man and to make his path an easy one. Naturally, we are gratified that he is as directly benefited as if this were the purpose. But no one has the right to forget that the military purpose is a stern and practical one. In keeping with that general purpose, the primary objectives of food acceptance investigations are themselves coldly practical. They are three: first, economy thru elimination of waste; second, improvement in operating efficiency of troops; and third, improved health through better nutrition under adverse feeding conditions.

We have probably made greater strides toward the first objective than either of the others. Historically, it was this problem of food wastage that triggered off the military interest. It all started from that most valid of observations of the behavior of military personnel; namely, when a service man's rations do not taste right, they are not eaten. It was a natural first step for the budding science of food acceptance methodically to determine what foods would and what foods would not be eaten in order to prevent the latter from ever reaching the rations. Hence the new science at an early moment demonstrated that it could subscribe to the good American tradition of harnessing theory to practice. Food acceptance and food preference studies have already pointed the way to significant reductions in food waste at many points in the feeding program of the Armed Services.

As for the second and third objectives, we cannot so easily cite chapter and verse as to the benefits attained. This demonstrates the truism that it is much easier to identify an existing fault than it is to design an adequate

solution. That is what we are trying to do in developing feeding methods for better efficiency and specialized rations for better nutrition under difficult conditions. But progress is being made. This progress shows most clearly in discovery of what the problems are and restating them so that they are more open to experimental attack, but we also can begin to see the effect on the rations. We will return to this later.

Here again I should like to advance an idea for you to consider. It is pure speculation, but it is interesting and, I believe, pertinent also. As you are no doubt aware, upon occasion the accusing question is thrown at our Army. "The Chinese soldier fights on a handful of rice, the Russian lives off the land. Why must we devote so much energy and money to feeding ours? Can not the American soldier do likewise; or at least, why can't he return to the hard-tack and beans of 30 years ago?" What the real answer to this question is matters very little; no one proposes to put it to a real test, for it is well accepted that military efficiency is improved through superior feeding just as it is improved by superior weapons. But how did we come by our definition of superior food? How does it happen to include the recognition of the importance of acceptability? In large part the responsibility for this can be placed upon our American food industries - of course, at the same time they should also have the credit. The tremendous advances of the food industry - and the meat industry is a notable example - by providing endless variety and by constantly improving products, have educated large segments of the American population to where their food habits demand quality. You have taught the public to be discriminating as to flavor, texture, color, and other acceptability factors. Food habits tend to be quite stable and when the American consumer enters the Army he certainly doesn't leave his civilian food habits behind.

Now let us examine briefly what all this means to Armed Forces feeding. As most of you are already aware, there are several major different solutions of the feeding problem depending upon situation. We will look at these in turn.

Whenever possible, as during basic and advanced training and in periods of inactivity, troops are fed at permanent installations in large groups. This is almost always the case within the continental United States. Here the ready access to normal food supplies permits a special kind of military feeding and we have what is known as the Field Ration A. I say that it is "special," but that is because the foods are very "non-special," being almost identical with those used in civilian feeding. Here the activities of the Quartermaster in supplying the dining halls of the numerous posts, camps and stations throughout the country are in many respects not too different from those of the manager of a huge restaurant chain. He works from a master menu, designed to attain variety, nutritional balance, and correct quantities. He has to consider availability of foods and their cost, in the latter aspect probably operating under stricter limitations than the restaurant chain manager need recognize. But the same foods are available to him - foods with which the service man was familiar in civilian life - and problems concerning the acceptability of these foods will be quite similar. As of the year 1952 I believe it can be correctly stated that on the average a commercial ham when placed before the Army man as part of the A-ration is as good a ham as it would be when placed before this same man at a restaurant table or in his own dining room at home.

Note that in speaking of some food products, e.g., ham, I stated that their acceptability is scarcely more of a problem for the Armed Forces than for commercial mass feeding. With certain qualifications this is true but only in regard to specific foods. But the Quartermaster (and to a lesser extent his Navy and Air Force equivalents) has another problem of major proportions which is hardly encountered by our hypothetical restaurant chain

manager. It lies in the fact he must use fixed menus, in each of which little or no choice can be allowed to feed the thousands of troops who subsist continually on the A-ration. These men are drawn from all over the nation. Their national, cultural, economic, educational, and religious backgrounds cover the entire range of possibilities. Their attitudes toward food and their customs of eating will be equally as varied. There is of course a tremendous amount of overlapping in the food habits of the various sub-groups but also great differences. Foods may be rejected not because they lack any of the qualities of appeal that are normal to the product, but because they may be unfamiliar or even tabu for one reason or another. A recipe which is highly preferred by half the Army is useless for army feeding if it is disliked by the other half. This fact imposes a restriction and presents a tangible, practical problem; that of determining what foods meet the criterion of being sufficiently well-liked by a large enough proportion of the Armed Forces. I am pleased to be able to report significant progress toward the solution of this problem. A two year survey program, conducted jointly by the Quartermaster Food & Container Institute and other elements of the Quartermaster Corps, is just now nearing completion. A method of obtaining information about food preferences based upon a questionnaire technique was developed and pilot-tested to correct deficiencies. Following this a series of large scale surveys, each one utilizing a random sample of Army enlisted personnel, was run to discover how well the men like the foods at present being served in the A-ration. The field surveys are now completed, although analysis of the data and the final report are not yet finished. The results of preliminary analyses have been made available to authorized personnel as the work progressed, and have already proved their value to menu planners by permitting the reduction or elimination of relatively unacceptable foods. Its value in procurement, since such menu planning directly affects purchases, is quite tangible - I mean in dollars and cents.

A second major type of Army feeding is that which requires use of the B-ration. Here again we are concerned with large groups of men in situations where there can be at least a little permanence in regard to preparation and eating facilities. This ration is primarily used for overseas feeding of groups in active training, also in rear areas during combat where it may extend its benefits toward the actual fighting to an extent only limited by the ingenuity of the food service personnel. In general it is the overseas ration for use wherever the logistic situation makes the A-ration impracticable. Master menus are planned just as with the A-ration but neither the planning nor the performance can be as precise as with the latter. The B-ration is almost exclusively dependent upon processed foods - canned, dehydrated, pickled, cured, etc. This is necessary because of the absolute need for long term storage stability. Immediately we find our choice of food items markedly restricted and we find the quality - and the acceptability - of a great many of those we can use definitely lowered. For example - dehydrated vegetables, milk, and eggs in place of the fresh products, canned fruits and vegetables, and, to come closer home, canned meats with their recognized loss of texture plus the old bugbear, "canned meat flavor." So far the main approach to improvement of the acceptability of this ration is detailed work on the quality of the individual items - a "divide and conquer" technique. Many lines of investigation are continually underway at the Institute and by its research contractors to improve stability, nutritive value, and flavor quality of the processed foods. Flavor and preference testing are an important aspect of the evaluation of any improvements. The flavoring agent, monosodium glutamate, is now under investigation as to its possible value to the B-ration. It is thought that it may improve preference for a number of its items.

The third type of feeding situation I will mention is that of individuals or small groups. It really represents a class which we can call that of the specialized feeding. There are rations designed for troops who must eat under many and varied conditions, e.g., a small group manning an anti-aircraft battery, operation of a weather station, a patrol mission in the Arctic, individual soldiers hitting an enemy beach or in the continuous grind of active combat. The Ration, Individual, Combat, better known as the C-ration, which you have heard much about since Korea, is a good example. With these specialized rations acceptance problems are both numerous and specialized. Not only do we meet all of the problems of storage stability, but utility becomes more and more important. When engaged in activities remote from kitchen-prepared meals the food a man carries has to compete with the other impedimenta - weapons, shelter equipment, ammunition, etc. Further, it must be simple to prepare so as not to divert his energies from the more important activities necessary to survive in the face of adverse circumstances. Such food has to be in a form which is compact and convenient, simple to prepare, yet high in nutrients and calories. As you can imagine, in order to attain these characteristics considerations of flavor and preference have to give ground and it becomes simply a matter of holding the line as stubbornly as possible. The dehydrated meat bar used in the Ration, Trail, Frigid is a good example. Here we have a product of good storage stability, with high caloric density for energy, low moisture both for stability and to avoid freezing, and adapted to simple preparation. I doubt that a person would ever choose to serve it for dinner when normal foods are available or would even use it for a quick lunch, but its flavor characteristics are good enough to assure its being eaten under the difficult conditions for which it was intended.

Here a parenthetical - and perhaps obvious - remark is in order. The Office of the Surgeon General has carefully calculated the nutritional values required by the soldier under various kinds of operating conditions; and the specialized rations are designed to meet those objectives. Yet if any substantial part of the ration were only nibbled and then thrown away the entire value of the careful nutritional plan would be lost and serious malnutrition could result.

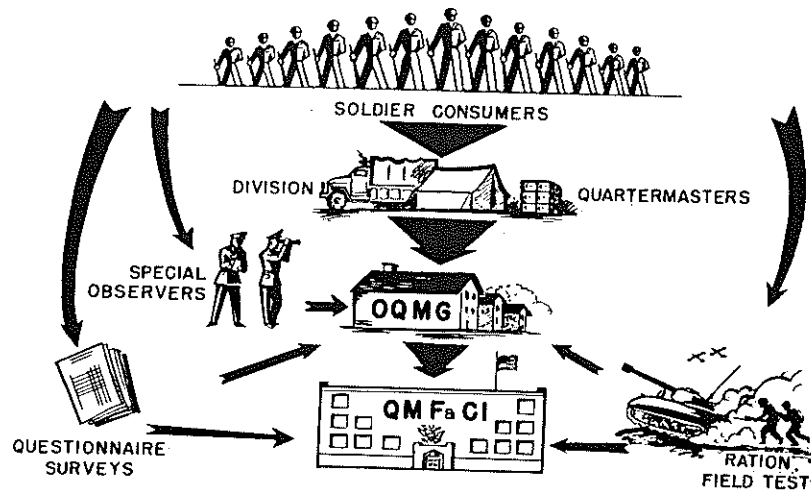
Concern with acceptance then plays a leading part in assuring the good "field performance" of rations. Even if the operation of acceptance control were only rudimentary - as when the company commander ceremoniously nibbles at the chow prior to every meal - it has at least a morale value. But when strengthened and directed by scientific method it can make a tremendous contribution. If there is truth in the old saying, attributed by fable to Napoleon, that an army travels on its stomach, it is equally true that the Army will travel faster and more willingly when the stomach can be filled with pleasure and with that sense of satisfaction that we well fed Americans insist upon almost as if it were guaranteed by the Bill of Rights.

With the background provided by this quick over-all view of typical military feeding situations in relation to food acceptance work we are ready to look at the work itself in a more detailed fashion. How are the field problems projected to the laboratory? What happens to them when they get there? How are research results in turn brought to bear in the practical feeding situation?

Where does the Institute get its information on ration deficiencies? What is it that sets off a phase of investigation? The answer to this question is more than a little complex and I have a chart that has been developed in order to present the situation more clearly. I can almost hear you object, "The picture is still confusing." This tells me that the chart is serving its proper purpose, for any attempt to describe the situation with simple boxes and lines would be unrealistic. The situation is complex, the sources are various,

lines of communication are not always direct, and the flow of information is intermittent. The chart does honor to the rank and file of troops as the ultimate source, what we actually get are observations of varying degrees of reliability about the behavior and attitudes of the men toward the rations. Sometimes they are random observations during actual operations, made by individuals of all ranks from private to general. Those who are responsible for feeding operations in the using services make official reports of ration performance which in effect usually do no more than accumulate and dignify the random observations. The QMC occasionally sends its own observers direct to the field to observe and report on ration performance. The flow of information from such sources lacks not so much in quantity as it does in quality. In general its reliability must always be questioned because it usually represents only a small sampling of the total number of users of the ration, and because the observations have not been made in a controlled manner.

Chart I



We are constantly seeking ways to direct and refine the flow of information and are particularly concerned with how we may obtain our data as directly as possible from the ultimate consumer: - the enlisted man in the field. The methods that have been tried may be divided into the two classes as motivated in the chart. One class is the ration use test in which a selected group of men use the rations while under controlled observation for a period of time. This is the method usually employed to test new rations before the Army is finally committed to their general use. There are two major difficulties in this type of testing. Frequently the troops are testing other items of supply such as clothing, equipment, etc. at the same time which may create somewhat artificial conditions; also the number of troops employed is small and there is danger of a biased sample. The other class is designated in the chart as "field surveys of preferences and attitudes." The surveys of soldier preferences for foods of the A-ration (described a moment ago) belong to this class as you will note. The problem of generalizing such an approach and making it apply to various rations under various conditions of operation is not an easy one. The A-ration surveys worked out well because we could deal with a fairly consistent situation. However, we are able to report several

attempts to extend this method. Three surveys have been conducted, or are underway, during training exercises designed to get information directly from the soldier on the specific performance of a specific ration. One such study was attempted in Korea among combat troops. Considerably more difficulty was encountered, but we were able to obtain useful and unquestionably valid information about the combat rations.

It must be frankly admitted that the validity of these various techniques and the worth of the resultant information is not definitely known. Some methods are suspect; in others we feel we can place more confidence. The precise difficulties are, of course, the lack of control, the small samples of unknown composition, and the consequent ever-present possibility of bias. We are assured of one thing; namely, that most of these field observations are derived from a valid use situation. Whatever other faults, such as lack of reliability, which must be assessed against them, one is generally assured that the ration use situation which they are attempting to describe is a representative one - an actual use situation.

I emphasize this point in order to throw into sharp contrast the situation which is met in the laboratory investigations, while we are working on problems uncovered in the field and when concerned with the pre-testing of new food items which are supposed to represent the solutions to those problems. Here there becomes possible a degree of control of test situations which is extremely good as compared to that maintained in making field observations. As a consequence, techniques are uniform and results tend to be quite reliable. But the question of the validity of test result remains still with us for two reasons: first, the experimental control which is established in the interests of reliability makes the conditions of use non-representative; and second, the tests are seldom able to employ a representative sampling of consumers.

This brings us logically to the next stage of acceptance evaluation of research and development results. You will begin to see the completion of a circle, for this next stage is represented by the so-called "engineering test" and the true field test. Both are run with soldier consumers under actual or semi-practical field conditions. The engineering test will be more limited in scope, being designed to test only certain aspects of the ration. Nor is it so much concerned with the adequacy of the consumer population in regard to size and representativeness. Field tests may vary in scope and the ambitiousness of their purpose. The essential and distinguishing characteristic of field tests is: that they require that performance of the test items be observed under the actual conditions of intended use by a sampling of the kind of troops for which it is intended. Note that this kind of test appears on our chart as one of the sources of information on ration inadequacies. When new items are given an adequate pre-test in the field during the course of development, this avoids most of the possibility of having any serious difficulty show up later after the item has been placed in large scale use. Of course, simply running what can be called a field test does not give full assurance that the final answer has been attained; for, by their very nature, field tests lack control and can fail to give accurate results.

Here is a situation with the characteristics of a dilemma. On the one hand we have the laboratory, where we can get reliable and precise results through careful control of test conditions and test subjects, but where we may lack full confidence in the results because of this very control and because of poor sampling. On the other hand there is the field test where both the sampling of the consumer population and test conditions are unquestionably valid, but we may lack full confidence because of the lack of control in our methods of testing. What can be done about this situation? Obviously, one approach is to refine and improve the techniques used in engineering and field tests. This is under way at the present time.

But there is another possibility which is at least tempting. Field tests are time consuming and expensive while laboratory testing can proceed at a much faster rate and as a matter of routine, given the proper facilities. Please note that I have not totally disqualified the laboratory results. I have only stated that one may lack full confidence. Obviously we must place a good measure of reliance in laboratory results in order to depend upon them for the preliminary stages. We are forced to make the assumption that such results predict field preference with at least a passable degree of precision, nor are we always disappointed. Indeed, the results show that there is a fairly good correspondence. The question then becomes pertinent, "How good is the correspondence?" We have recently set out to answer this question by methodical experimentation in which preference tests will be run on the same foods in the laboratory and under various field conditions. The results may tell us that we should discard laboratory testing entirely, however, it seems more likely that they will tell us that we can treat such data with more respect.

I have talked at some length about preference and acceptance testing in general, but have not mentioned any methods in particular. Now I would like to discuss some of the techniques which are being used by the Quartermaster Corps for various problems, both those which are restricted to the laboratory operations and those which can apply also in the field.

The fundamental problem in acceptance work is that of preference, and perhaps here we should come to some understanding on definitions. "Preference" is, in a sense, the wrong word to describe the tests that are run since they are seldom concerned with choices of one item over another. The tests are directed, instead, toward the more practical end of determining the attitude and degree of liking toward individual items. But why they are called "preference" is doubtless understood by most people.

Again, it is recognized that actual food acceptance is determined by a variety of factors in addition to the one we call preference or degree-of-liking. To mention only a few: the physical condition of the consumer, his mental attitude, his appetite, his food habits, the climate, and the availability of competing foods. Preference will vary independently on some of these factors but on the other hand some of these will determine preference. The thing that is of critical importance to us is that preference seems to be the most important single factor in predicting acceptance. It also has the advantage of being easily measured.

There are several different basic methods of measuring food preferences available, such as: paired comparisons, rank order, and rating scales. Most of you are just as familiar with these methods and their variations as the Institute technologists. All are employed at various times in the Institute Acceptance Laboratory and some in the engineering or field tests. However, there is one method relating to consumer acceptance or preference which I would like to describe in some detail. It was developed at the Institute in 1949 and was placed into actual use for preference testing before it had been sufficiently verified. However, it has proved to be quite satisfactory and has become almost the standard method for Quartermaster Corps food preference work. It has been given a special name - the hedonic scale method. This fancy name was selected as Hedonic value is one term made use of by psychologists to express that intangible quality of human attitude that we are trying to measure.

A questionnaire which employs the hedonic scale is shown in Chart II. This happens to be the form which is used for general testing in the laboratory, but the scale can be presented in a variety of forms depending upon the test conditions, number of test items, type of test subjects, etc. You will further

note that this is no more than another application of the basic rating scale approach which is familiar to almost anyone who has been engaged in food preference work. The difference here lies in the type of response which is called for. Note that the nine points of the scale are described with phrases indicating degrees of "like" and "dislike." The instructions to the observer urges him to respond on the basis of his own immediate feeling, rather than to attempt to make a judgment of the quality of the food. The intent is to avoid as much as possible any reflective consideration of the problem, on the theory that it is the naive, uncomplicated response which determines our pleasure in eating and also governs the formation of attitudes and future preference choices.

Chart II Hedonic Scale Questionnaire. Laboratory Preference Form

INDICATE YOUR REACTION BY CHECKING A POINT ON THE SCALE

Code: \_\_\_\_\_

Code: \_\_\_\_\_

Like
Extremely
Like
Very Much
Like
Moderately
Like
Slightly
Neither Like
Nor Dislike
Dislike
Slightly
Dislike
Moderately
Dislike
Very Much
Dislike
Extremely

Like
Extremely
Like
Very Much
Like
Moderately
Like
Slightly
Neither Like
Nor Dislike
Dislike
Slightly
Dislike
Moderately
Dislike
Very Much
Dislike
Extremely

COMMENTS:

COMMENTS:

It is not necessary to train people in the use of this scale. As a matter of fact, experience with the method may do more harm than good. The soldier who sees the scale only once during a field test probably answers more nearly in the desired way than the laboratory observer who uses it perhaps once a week throughout the year. Laboratory observers tend to develop a judgment attitude in which they attempt to pass on the quality of foods rather than the quality of their own responses. For this reason in selecting observer groups in the laboratory situation certain classes of persons are avoided, such as food technologists, members of trained taste panels, and anyone who is fa-



miliar with the item being tested. Also as large a group as possible is kept under call so that any one individual's participation in tests of this type is held to a minimum. There is, of course, no similar problem in the field for the soldiers are seldom tested the second time.

People's food likes and dislikes tend to spread over a broad range. Correspondingly, the responses from any group of consumers to almost any food will tend to spread over a considerable range of the hedonic scale. Statistically we would say that the variability is high. It follows that the test groups must be fairly large to get reasonable precision and reliability in the results. Laboratory tests will utilize a minimum of 40 observers. The number of men participating in a field test often must be determined by considerations other than expected reliability of the test, and sometimes fewer than 40 will be used. Usually, however, field tests have much larger groups available. For example, in the Army-wide surveys of preference for A-ration foods and recipes, from 5,000 to 7,000 men completed questionnaires in each survey. Results on the scale are summarized by assigning the values of 1 to 9 to its successive points, beginning at the "dislike extremely" end, then calculating the arithmetic mean. Another index which is found to be quite useful is the percentage of observers indicating any degree of dislike. Because of the limitation of time I will be able to give only a cursory discussion of the interpretation. After making a few assumptions about the data (which the simon-pure statistician might question), they can be analyzed by the usual statistical procedures and the significance and statistical precision of the results can be established. Thus ration items and groups of observers can be compared on the basis of the average hedonic ratings. Further, from the experience we have accumulated thus far we are building up a concept of the significance of the absolute values of the hedonic ratings, and even now we can make general predictions as to the probable acceptance of a ration item on that basis.

The Institute laboratory normally is concerned with a number of different kinds of sensory testing in addition to consumer preference. These will include: (1) evaluation of food quality from the technical standpoint through use of trained taste panels, (2) measurement of flavor differences as such, apart from the effect of such differences on acceptance, (3) analysis and description of complex flavors, and (4) measurement of flavor intensity. Tests of these factors are employed in support of various aspects of the research and development work on food, i.e., on problems such as recipe formulation and determination of the effects of changes in processing methods or of the effects of storage. However, consumer preference remains the basic problem.

Up to this point acceptance and preference have been treated as relatively uncomplicated problems. We must treat them in this manner at the present time since as yet we do not know how to handle simultaneously some of the important complicating factors even though we know that they do exist. There is evidence to show that a number of things may disturb the predictions about acceptance which are so laboriously achieved. To give a few examples: (1) the physiological stresses of climatic extremes, (2) the emotional and physical stresses that arise in combat, and (3) the factor called "monotony." Such problems as these are of great practical interest to the Armed Forces and we are starting to blaze some research trails into this virtually uncharted area. The objective is: to determine the direction and nature of the effects that such disturbing factors have on normal patterns of food acceptance. As the data from these investigations become available we feel certain that it will become possible to accurately predict acceptance in, and to design rations for, specialized military conditions that the present day acceptance predictions do not afford.

Chart III - Hedonic Scale Questionnaire. Attitude Survey Form

	FOOD ITEM	LIKE				INDIF- FERENT	DISLIKE			
		Like Extremely	Like Very Much	Like Moder- ately	Like Slightly		Dislike Slightly	Dislike Moder- ately	Dislike Very Much	Dislike Extremely
Not Tried	Roast beef					Neither Like nor Dislike				
Not Tried	Peaches (canned)					Neither Like nor Dislike				
Not Tried	Chocolate milk					Neither Like nor Dislike				
Not Tried	Apple pudding					Neither Like nor Dislike				
Not Tried	Buttered whole kernel corn					Neither Like nor Dislike				
Not Tried	Hamburgers					Neither Like nor Dislike				
Not Tried	Jam					Neither Like nor Dislike				
Not Tried	Fried hominy grits					Neither Like nor Dislike				
Not Tried	Sliced cucumbers					Neither Like nor Dislike				